Simulator training and residents' first laparoscopic hysterectomy : A randomized controlled trial

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totally abrogated the STAT3-mediated luciferase signal, was used as
In addition, we evaluated the role of knockdown in the STAT3
expressing cells. While knockdown nearly completely blocked
(wt) transcriptional activity, it had only a partial effect on the STAT3
2B), as has been reported before [9, 18]. From the primary screen co
selected 182 genes which were retested by assessing the effect of the
in separate wells (Fig 2A, S2File).

From these, we identified 25 hit candidate genes whereat least 2 c
confirmed. Seven genes validated in a follow-up screen using three a
different vendor (Fig 3A and 3B and S2File). Knockdown of the kina
, , and resulted in inhibition of both STA
(wt) reporter signals (Fig 3A and 3B). Conversely, knockdown of

Simulator training and residents rst laparoscopic hysterectomy: a randomized controlled trial

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Abstract

Background Hysterectomy rates are decreasing in many countries, and virtual reality simulators bring new opportunities into residents surgical education. The objective of this study was to evaluate the e ect of training in laparoscopic hysterectomy module with virtual reality simulator on surgical outcomes among residents performing their rst laparoscopic hysterectomy.

Methods This randomized study was carried out at the Department of Obstetrics and Gynecology in Helsinki University Hospital and Hyvinkää Hospital. We recruited twenty residents and randomly signed half of them to train ten times with the laparoscopic hysterectomy module on a virtual reality simulator, while the rest represented the control group. Their rst laparoscopic hysterectomy was video recorded and assessed later by using the Objective Structured Assessment of Technic Skills (OSATS) forms and Visual Analog Scale (VAS). The scores and surgical outcomes were compared between the groups.

Results The mean OSATS score for the Global Rating Scale (GRS) was 17.0 (SD 3.1) in the intervention group and 11.2 (SD 2.4) in the control group (p 0.002). The mean procedure-speci c OSATS score was 20.0 (SD 3.3) and 16.0 (SD 2.8) (p = 0.012), and the mean VAS score was 55.0 (SD 14.8) and 29.9 (SD 14.9) (p 0.001). Operative time was 144 min in the intervention group and 165 min in the control group, but the di erence did not reach statistical signi cance (p 0.205). There were no di erences between the groups in blood loss or direct complications.

Conclusion Residents training with a virtual reality simulator prior to the rst laparoscopic hysterectomy seem to perform better in the actual live operation. Thus, a virtual reality simulator hysterectomy module could be considered as a part of laparoscopic training curriculum.

Fig 2. Small interfering RNA (siRNA) screen to identify regulators of hyperactive STAT3. (A) General distribution of the

Keywords Surgical education • Resident education • Virtual reality simulator • OSATS • VAS

Although the number of live operations in residents train- ing has diminished [1], technology o ers new solutions for surgical training in the form of lap trainers and virtual real- ity simulators [2 5]. With these training tools, it is possi- ble to acquire fundamental laparoscopic skills [2], and they may be used as a part of the procedural training curriculum [6], as well. Though procedural skills have been proven to be transferred into the operating room after virtual reality simulator modules in laparoscopic cholecystectomy [7], laparoscopic salpingectomy [8], and in cataract surgery [9], no data exists on the e ect of virtual reality simulators on advanced major surgical procedures [10].

In gynecology, hysterectomy is a major benign surgery and it is simultaneously one of the most common gyneco- logical procedures [11]. In this study, our aim was to eval- uate the effect of training with the laparoscopic hysterec- tomy module on a virtual reality simulator on a resident s first laparoscopic hysterectomy as a first surgeon.

Materials and methods

For this interventional and blinded study, 20 residents were enrolled between June 2013 and March 2016. The participants came from Helsinki University Hospital and Hyvinkää Hospital. All residents in gynecological surgery rotation with experience in laparoscopic diagnostic and adnexal surgery as a first surgeon, as well as assisting in more advanced laparoscopic procedures, were invited. None of the residents fulfilling the criteria declined to

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participate. Laparoscopic hysterectomy as a first surgeon or training with hysterectomy module with a virtual reality simulator were exclusion criteria. Participants were randomized using sealed envelopes into two equal size intervention and control groups by a research assistant outside the study.

Participant demographics were collected by questionnaires. They included age, experience in obstetrics and gynecology and in general surgery, experience in diagnostic and adnexal surgery as a first surgeon, and ongoing or past video game and musical instrument playing habits. Patient- and surgery-related data were collected from the medical records. They included age, body mass index, previous abdominal surgery, Cesarean sections and deliveries, weight of the removed uterus, concomitant adnexal surgery, operating time, blood loss, and complications.

All participants in the intervention and control group did the web-based theoretical course 'Basics in gynecological laparoscopy' [12], and trained five times each of the nine basic skill tasks in the same virtual reality simulator (LAP Mentor, Simbionix Corporation, Cleveland, Ohio, USA). Thus, all participants did the same intervention that was used in our recent study to evaluate its effect on residents' first operative laparoscopy [13]. These practice sessions were automatically recorded and were used to assess the technical skill level in the beginning of the study. A composite score [14] was calculated for each task to standardize different dimensions

was used. The categorial variables were calculated by Chi-Square Tests. The reliability analysis was done by the Intraclass Correlation Coefficient test, and correlations for the parametric variables by the Pearson-Correlation test and for non-parametric variables by Spearman's rho. In analyses of learning curves, we used the Friedman test and the Wilcoxon Signed Rank Test. In the validation study, we used the Kruskal–Wallis test and Mann–Whitney U tests in post hoc analysis with Bonferroni adjustment.

The Hospital District of Helsinki and Uusimaa and

intervention group was 20 min shorter, although this di er ence was not statistically signi cant.

In a recent study [16], with virtual reality training cur riculum for laparoscopic hysterectomy, results showed that the learning curves plateaued after 4–6 training sessions. In our study with the same parameters, plateaus in learn- ing curves were reached already after the third training session, although the training performance improved in many parameters thereafter. At the end of the training program in our intervention group, six out of ten participants reached the set criteria. This demonstrates the importance of pro ciency-based training programs instead of repetition-based. However, we were unable to show an association between the operation outcome and training program performance.

When assessing technical skills in the operating room [17], two main assessment tools have been identified: global rating scales (original or modified version of OSATS tool, or the Global Operative Assessment of Laparoscopic Skills tool, GOALS) and task-specific checklists. We used original OSATS tool for global rating skills, but we showed construct validity of a new OSATS form modified for laparoscopic hysterectomy.

unfortunately this form was not available at the time our study was ongoing.

The VAS score is typically used to assess pain or anxiety among patients, but it can be also used for other purposes, e.g., among residents for assessing their own management in a special kind of anesthesia [21], and in assessing the overall quality of patient sign-out from the emergency department [22]. For trainees' surgical skills, the VAS score has been used to evaluate suturing and knot tying skills [23], showing the VAS score and the OSATS for global rating skills 'good' for educational purposes with interrater reliability (IRR) 0.71 in a group where assessors were trained to the use of scales. The IRR was

treatment (S1 File). Subsequently, we calculated a drug sensitivity score (DSS) that measures the area under the dose response curve and represents the efficacy and potency for each compound [21, 23]. When we compared the DSS values of STAT3(wt) and STAT3(Y640F) expressing cells we did not see clear differences in the viability readout (Fig 1A). In the cell toxicity readout, on the other hand, we observed that STAT3(Y640F) is protecting cells from cytotoxic responses against